

WHAT IS CLAIMED IS:

1 1. An electrical apparatus comprising:
2 two terminals accessible from an exterior of the electrical apparatus;
3 an electrical element comprising a monolithic MOV disk having an outer surface and
4 two ends, the ends being in contact with the two terminals; and
5 a reinforcing structure attached to the outer surface, wherein the reinforcing structure
6 comprises a fiber matrix pre-impregnated with a resin.

1 2. The apparatus of claim 1 wherein the monolithic MOV disk has a rating
2 greater than 6 kV.

1 3. The apparatus of claim 1 wherein the monolithic MOV disk has a rating
2 between approximately 6 kV and approximately 800 kV.

1 4. The apparatus of claim 1 wherein the electrical apparatus is constructed so as
2 to withstand at least one 100 kA impulse.

1 5. The apparatus of claim 1 wherein the fibers in the fiber matrix are oriented in
2 a predetermined orientation.

1 6. The apparatus of claim 1 wherein the fibers in the fiber matrix are oriented
2 parallel to an axis of the electrical element.

1 7. The apparatus of claim 1 wherein the fibers in the fiber matrix are oriented in
2 a random orientation.

1 8. The apparatus of claim 1 wherein the fibers in the fiber matrix are of a
2 uniform length.

1 9. the apparatus of claim 1 wherein the fibers in the fiber matrix are of a non-
2 uniform length.

1 10. The apparatus of claim 1 wherein the fibers in the fiber matrix comprise
2 fiberglass.

1 11. The apparatus of claim 1 wherein the fibers in the fiber matrix comprise a
2 non-conductive material.

1 12. The apparatus of claim 1 wherein the fiber matrix is applied circumferentially.

1 13. The apparatus of claim 12 wherein the fiber matrix is applied
2 circumferentially such that the fibers have a predetermined orientation at a predetermined
3 angle.

1 14. The apparatus of claim 13 wherein the predetermined angle is an angle less
2 than approximately 50 degrees.

1 15. The apparatus of claim 14 wherein the angle is between approximately 3
2 degrees and approximately 10 degrees.

1 16. The apparatus of claim 12 wherein the circumferentially applied fiber matrix
2 has a predetermined thickness.

1 17. The apparatus of claim 1 wherein the pre-impregnated fiber matrix is applied
2 vertically.

1 18. The apparatus of claim 17 wherein the vertical application comprises at least
2 one piece of fiber matrix placed in a vertical orientation along an axis of the electrical
3 element.

1 19. The apparatus of claim 17 wherein the vertical application comprises a single
2 piece of fiber matrix placed in a vertical orientation along an axis of the electrical element
3 and having a sufficient width to cover the majority of an outer surface of the electrical
4 element.

1 20. The apparatus of claim 1 wherein the reinforcing structure further comprises
2 at least one layer of pre-impregnated fiber matrix applied circumferentially and at least one
3 layer of pre-impregnated fiber matrix applied vertically.

1 21. The apparatus of claim 1 wherein the reinforcing structure comprises a
2 coating of fiber segments embedded in an epoxy.

1 22. An electrical apparatus comprising:
2 an electrical element comprising a bonded disk stack having an outer surface; and
3 a reinforcing structure attached to the outer surface, wherein the reinforcing structure
4 comprises a fiber matrix pre-impregnated with a resin.

1 23. The apparatus of claim 22 wherein the disk stack comprises more than one
2 MOV disk.

1 24. The apparatus of claim 22 wherein the fibers in the fiber matrix comprise a
2 non-conductive material.

1 25. The apparatus of claim 22 wherein the fiber matrix is applied
2 circumferentially.

1 26. The apparatus of claim 22 wherein the pre-impregnated fiber matrix is applied
2 vertically.

1 27. The apparatus of claim 22 wherein the reinforcing structure comprises at least
2 one layer of pre-impregnated fiber matrix applied circumferentially and at least one layer of
3 pre-impregnated fiber matrix applied vertically.

1 28. A method of reinforcing an electrical apparatus, the method comprising:
2 providing at least one electrical element comprising a monolithic MOV disk having
3 an outer surface and two ends, each end being in contact with a terminal accessible from an
4 exterior of the electrical apparatus;

5 preparing a reinforcing layer for application to the outer surface of the electrical
6 element, wherein the reinforcing layer comprises a fiber matrix pre-impregnated with resin;
7 and
8 applying the reinforcing layer to at least a portion of the outer surface of the at least
9 one electrical element.

1 29. The method of claim 28 wherein the monolithic MOV disk has a rating
2 greater than 6 kV.

1 30. The method of claim 28 wherein the monolithic MOV disk has a rating
2 between approximately 6 kV and approximately 800 kV.

1 31. The method of claim 28 wherein the electrical apparatus is constructed so as
2 to withstand at least one 100 kA impulse.

1 32. The method of claim 28 wherein applying the reinforcing layer comprises
2 circumferentially applying a pre-impregnated fiber matrix.

1 33. The method of claim 28 wherein applying the reinforcing layer comprises
2 vertically applying a pre-impregnated fiber matrix.

1 34. The method of claim 28 further comprising performing post application
2 processing of the reinforcing layer.

1 35. The method of claim 34 wherein performing post application processing
2 comprises curing.

1 36. The method of claim 28 further comprising heating the element.

1 37. The method of claim 36 wherein the element is heated between approximately
2 100° F and 200° F.

1 38. The method of claim 35 wherein curing the reinforcing layer comprises
2 heating the reinforcing layer.

1 39. The method of claim 38 wherein the reinforced layer is heated to between
2 approximately 250° F and 400° F.

1 40. A method of reinforcing an electrical apparatus, the method comprising:
2 providing at least one electrical element comprising a bonded disk stack having an
3 outer surface;
4 preparing a reinforcing layer for application to the outer surface of the electrical
5 element, wherein the reinforcing layer comprises a fiber matrix pre-impregnated with resin;
6 and
7 applying the reinforcing layer to at least a portion of the outer surface of the at least
8 one electrical element.

1 41. The method of claim 40 wherein applying the reinforcing layer comprises
2 circumferentially applying a pre-impregnated fiber matrix.

1 42. The method of claim 40 wherein applying the reinforcing layer comprises
2 vertically applying a pre-impregnated fiber matrix.

1 43. The method of claim 40 further comprising performing post application
2 processing of the reinforcing layer.

1 44. The method of claim 40 wherein performing post application processing
2 comprises curing.

1 45. A method of reinforcing an electrical apparatus, the method comprising:
2 providing at least one electrical element comprising a monolithic MOV disk having
3 an outer surface and two ends, each end being in contact with a terminal that is accessible
4 from an exterior of the electrical apparatus;

5 preparing a reinforcing layer for application to the outer surface of the electrical
6 element, wherein the reinforcing layer comprises a fiber matrix having a mixture of fiber
7 segments pre-impregnated with resin; and
8 applying the reinforcing layer to at least a portion of the outer surface of the at least
9 one electrical element.

1 46. The method of claim 45 wherein applying the reinforcing layer comprises
2 coating the element by dipping the element in the mixture of fiber segments and resin.

1 47. The method of claim 45 wherein applying the reinforcing layer comprises
2 coating the element by casting in a pre-impregnated fiber matrix.

1 48. The method of claim 45 wherein applying the reinforcing layer comprises
2 coating the element by powder coating in a fiber matrix.

1 49. The method of claim 45 wherein applying the reinforcing layer comprises
2 coating the element in a fiber matrix.

1 50. A method of reinforcing an electrical apparatus, the method comprising:
2 providing at least one electrical element comprising a bonded disk stack having an
3 outer surface;
4 preparing a reinforcing layer for application to the outer surface of the electrical
5 element, wherein the reinforcing layer comprises a fiber matrix having a mixture of fiber
6 segments pre-impregnated with resin; and
7 applying the reinforcing layer to at least a portion of the outer surface of the at least
8 one electrical element.

1 51. The method of claim 50 wherein applying the reinforcing layer comprises
2 coating the element by dipping the element in the mixture of fiber segments and resin.

1 52. The method of claim 50 wherein applying the reinforcing layer comprises
2 coating the element by casting in a pre-impregnated fiber matrix.

1 53. The method of claim 50 wherein applying the reinforcing layer comprises
2 coating the element by powder coating in a fiber matrix.

1 54. The method of claim 50 wherein applying the reinforcing layer comprises
2 coating the element in a fiber matrix.

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